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(54) Title: LIQUID FOOD SUSPENSION

(57) Abstract: The invention provides a liquid food composition in the form of a suspension of particles of foodstuff in a carrier liquid, excluding sugar-in-oil suspensions and nut pastes and nut butters; the particles having a mean particle size of less than 100 micrometres and a particle size distribution whereby the d[0.5] value is less than 100 micrometres and the d[0.9] value is less than 300 micrometres. The food composition can be for example a coating composition for snack foods or a sauce or bread improver composition.

LIQUID FOOD SUSPENSION

This invention relates to liquid suspensions of foodstuffs such as sauces, bread improver compositions, coating composition for food items, and more particularly to a flavouring and/or seasoning composition for food items such as snack foods. The invention also relates to food items coated with the compositions and to methods of preparing and using the compositions.

Background of the Invention

Snack foods such as potato crisps, corn chips and pork scratchings are usually coated with a seasoning and/or flavouring composition in order to render the often bland tasting basic food item palatable. Such coating compositions can consist predominantly of a seasoning such as salt (e.g. in the case of potato crisps) or can have a more complex composition.

The coating behaviour of suspensions is discussed in the paper by E.R. Lang & C.K. Rha, *Journal of Food Science*, Vol. 47 (1981), 324-325 which discloses tests carried out on *inter alia* sugar-in-oil suspensions. The authors found that suspensions having a sugar content of 1-30% gave a thicker coating on a glass plate when the sugar was a relatively coarse granulated sugar (446-465 micrometre diameter particles), but that suspensions having a sugar content of 60% gave thicker coatings when powdered sugar (22-31 micrometre diameter) was used.

The behaviour of food suspensions is also discussed (although not in a coating sense) in a number of patents to Procter & Gamble relating to nut pastes, nut spreads and nut butters, see in particular US-A-5693357, US-A-5518755 and WO-A-96/21364. The suspensions disclosed in the aforementioned documents, which contain relatively high concentrations of solids (greater than 50%) and are described as being spreadable, are milled using a high shear milling technique to give monomodal suspensions having carefully controlled particle size distributions.

EP-A-0 021 483 (also to Procter & Gamble) discloses flavour enhancing compositions comprising microfine salts having particle sizes of 1 to 10 microns.

US-A-4,375,483 (Procter & Gamble) discloses a flavour-enhancing fat composition containing salt, lecithin and a hydrophilic fumed silica. The combination of the salt and lecithin is stated as providing a synergistic improvement of the anti-stick properties of the fat composition.

Coating compositions are typically applied to a food item (e.g. snackfood) by spraying, tumbling or dipping techniques in which the coating is presented as a suspension or powder. A substantial problem with present coatings is that they are often poorly adherent to the food substrate with the result that a substantial proportion of the coating falls off the food substrate thereby clogging up the coating machinery. Not only is this wasteful of materials but, in addition, it is wasteful of time and labour since it is necessary to stop the machinery at regular intervals to clean off the accreted waste coating.

EP-A-0 518 507 (Pauls plc) discloses a method of preparing a flavouring material for application to a snack food base by milling particles of powdered flavouring in oil to a size of less than 20 microns. However, it is stated on page 2 of this document that the use of conventional free-flow agents such as tricalcium phosphate and exploded silica powder is detrimental to the process, tending to cause gelification of the flavouring mixture as a result of the milling step.

It is an object of the invention to overcome or at least substantially alleviate the aforementioned problems and to provide a coating composition which exhibits improved adherence to the food item thereby reducing the frequency with which the machinery used to apply the coating must be cleaned and production halted.

A further object of the invention is to provide a method and composition that are compatible with conventional free-flow agents, for example of the aforementioned type.

Another problem associated with suspensions is that present suspensions are often relatively unstable in the sense that separation and/or sedimentation of the solids takes place after a relatively short time. Consequently, there is a lack of uniformity in the coatings which

in turn can lead to taste "hot spots", or spots where there is little or no flavouring at all.

It is thus a still further object of the invention to provide a coating composition in which the flavouring and seasoning agents are spread more evenly over the food item thereby ensuring greater consistency of taste.

The problem of the settling out and sedimentation of food suspensions is also evident in many other areas of food technology, for example in the preparation of sauces (e.g for presentation with cooked food dishes) and hence another object of the invention is to provide a solution to the problems encountered with such other food suspensions .

Summary of the Invention

It has now been found that by carefully controlling the particle sizes of the solids within the suspension, more stable liquid suspensions can be obtained, such that settling out of the ingredients is arrested or substantially prevented. In the context of coatings for snack foods, this means that the flavouring and/or seasoning agent in the coatings can be applied with much greater consistency and with greatly reduced need to stop production runs to clean the equipment to remove coating material that has failed to adhere to the food item.

Accordingly, in a first aspect, the invention provides a liquid food composition in the form of a suspension of particles of foodstuff in a carrier liquid, excluding sugar-in-oil suspensions and nut pastes and nut butters; the particles having a mean particle size of less than 100 micrometres and a particle size distribution whereby the d[0.5] value is less than 100 micrometres and the d[0.9] value is less than 300 micrometres.

By "sugar-in-oil suspensions" is meant a suspension consisting substantially only of sugar and oil, for example a suspension of the type disclosed in Lang *et al.* (*idem.*).

The food suspensions of the invention are typically pourable or pumpable suspensions, i.e. suspensions having a viscosity at room temperature or on gentle warming to a temperature of up to about 50 degrees C (e.g. up to 45 degrees C) whereby they can be poured from a receptacle or can be pumped around a liquid transport or distribution system, e.g. through pipework, without the use of excessive pressures.

The compositions of the invention are in the form of suspensions in which, typically, the solids content can be of the order of approximately 15% to 55% (w/w), for example from 20% to 49% (w/w), preferably from 25% to 35%, e.g. approximately 30% (w/w).

The carrier liquid can comprise or consist essentially of water or a mixture with a miscible non-aqueous liquid, or the carrier liquid can be one which is immiscible with water. In one embodiment, the carrier liquid is an oil. The carrier liquid can contain dissolved substances where desired.

Examples of types of food suspensions are functional food suspensions such as drinks (e.g. stimulant suspensions, isotonic/energy drinks, recovery/jet lag cure drinks), sauces (e.g. sauces selected from curry, garlic, bechamel, tomato, cheese, butter, gravy, chocolate, vanilla and lemon sauces), glazes, bouillons, marinades and custards, bread improver suspensions, yield improvers, phosphate suspensions, functional protein suspensions, coating suspensions (e.g. for snackfoods), preservatives, colouring agents and colouring systems, and batters.

In one preferred aspect, the invention provides a coating composition (other than a sugar-in-oil suspension or a nut butter or nut spread) for coating a food item, the coating composition being in the form of a suspension of particles in a carrier oil; the particles having a mean particle size of less than 100 micrometres and a particle size distribution whereby the d[0.5] value is less than 100 micrometres and the d[0.9] value is less than 300 micrometres.

In a particularly preferred embodiment, the invention provides a coating composition (other than a sugar-in-oil suspension or a nut butter or nut spread) for coating a food item (such as a snack food), the coating composition being in the form of a suspension of particles in a carrier oil; the particles having a mean particle size of less than 50 micrometres (for example less than 20 micrometres, preferably less than 15 micrometres) and a particle size distribution whereby the d[0.5] value is preferably less than 20 micrometres, the composition having a solids content of from 20% to 49% (w/w) (preferably from 20% to 35%, for example 25% to 35%), and containing a free-flow enhancing agent.

In another preferred aspect, the invention provides a snackfood item coated with a coating composition as hereinbefore defined.

The term "d[0.5]" as used herein refers to the breadth of the range of particle sizes containing 50% of the particles. Thus, for example, if 50% of the particles are of a size in the range from 20 micrometres to 50 micrometres, the d[0.5] value is 50 - 20 = 30. Similarly, the terms "d[10]" and "d[90]" refer respectively to the breadths of the particle size ranges containing respectively 10% and 90% of the particles. The d[0.1], d[0.5] and d[0.9] values thus provide a means of determining and defining the particle size distribution in the suspension. It is preferred that the particle size distribution is controlled such that the d[0.5] value is less than 20 micrometres, typically less than 15 micrometres and more preferably less than 10 micrometres. It is also preferred that the d[0.9] value is less than 250 micrometres, for example less than 200 micrometres, preferably less than 50 micrometres. It is further preferred that the d[0.1] value is less than 10 micrometres.

The particle sizes referred to above are the particle sizes that can be measured using the "Mastersizer" laser particle sizer available from Malvern Instruments Ltd, Malvern, UK.

In one preferred embodiment of the invention, the coating composition contains particles having a mean particle size of less than 50 micrometres (for example less than 20 micrometres, preferably less than 15 micrometres) and a particle size distribution such that the d[0.5] value is less than 20 micrometres.

In a more preferred embodiment, the coating composition has a particle size distribution such that the d[0.1] value is less than 8 micrometres (e.g less than 5 micrometres), the d[0.5] value is less than 15 micrometres (e.g. less than 10 micrometres) and the d[0.9] value is less than 25 micrometres (e.g. less than 20 micrometres).

It is preferred that the particle size distribution is monomodal, i.e. the particles have a single size distribution curve, rather than several overlapping size distribution curves. In compositions where the components are comminuted separately before blending and have significantly differing mean particle sizes and size distribution profiles, the size distribution curve of the mixture may show several peaks and/or shoulders. By contrast, in a monomodal suspension, the size distribution curve should take the form of a single gaussian curve with no additional peaks or shoulders. Such monomodal particle distributions can be achieved either by milling the components separately to a desired consistent particle size, or by blending the components and milling the blend or mixture together to the desired size.

By controlling the particle size distribution in the suspension, it has been found that not only are the suspensions much more stable, i.e. they do not separate so readily on standing, but they exhibit greatly improved adhesion characteristics. The improvement in adhesion is believed to arise from the increased viscosity of the suspensions, and it has been found that good adhesion properties result from suspensions having a viscosity in the range from 30 $mPas^{-1}$ to 200 $Mpas^{-1}$. The foregoing viscosity figures refer to viscosities measured using a water bath set at 45 degrees C and a Brookfield DV-1 Viscometer having a number 2 spindle rotating at 100 rpm.

In one embodiment of the invention, the coating compositions are intended as coatings for snack food items. Examples of snack food items include food items which are extruded and/or fried and/or baked and/or formed by sheeting and/or reconstituted, and which are formed, for example, from root or tuber crops such as potatoes, cereals such as wheat, non-root crop vegetables and pulses, flours made therefrom or starch extracted therefrom, particular examples being maize flour, semolina or wheat flour, rice or rice flour, peanuts and other nuts.

Particular examples of snack foods are crisps and chips formed from potato and other vegetable and fruits including reconstituted forms thereof, pretzels (e.g. mini-pretzels or pretzel biscuits)), tortilla chips, savoury and sweet biscuits, extruded expanded snack items such as those sold under the trade marks "Wotsits" and "Monster Munch", collets or hoops formed from potato or cereal flour (for example hoops sold under the trade mark "Hula Hoops", unleavened or leavened baked dough products, fried bread snackfoods such as croutons, crusted crouton slices, pork rinds (scratchings) and popcorn.

Where the suspensions of the invention are coating compositions, typically they comprise (or consist essentially of) flavouring or seasoning components and optionally diluents or carriers therefor. The flavouring and seasoning components of the suspensions can comprise any one or more types of ingredient selected from base materials, flavoured base materials, processing aids, acidic base materials, flavours, herbs and spices, flavour enhancers, colours, and artificial sweeteners.

Examples of base materials include sugars such as sucrose, glucose (e.g. dextrose), fructose, lactose and maltose, and sodium chloride.

Flavoured base materials include onion powder, tomato powder, dairy powders such as milk, whey and casein powders, garlic powder, other vegetable powders and cheese powder.

Processing aids include agents intended to improve the properties of the suspensions and to assist the manufacturing process but which do not necessarily impart any flavour to the suspension. Examples include free-flow enhancing agents and humectants/dampening agents, particular examples being oils/glycerides, phosphates and silicas.

In a preferred embodiment, the compositions of the invention contain free-flow enhancing agents such as phosphates, for example calcium phosphates e.g. tricalcium phosphate.

Acidic base materials can be included, for example to create the impression or flavour of a fruit or other acid substance (e.g. to provide a citrus, apple or other fruit background), and examples include acids such as citric, ascorbic, malic, succinic, tartaric and acid salts such as acetates, and citrates.

Examples of flavours are natural flavours (e.g. extracts such as oleoresins), powders, solutions or purees from natural flavouring sources, and flavours that contain topnotes identical or substantially identical to naturally occurring flavours. Particular examples of flavours include cheese, dairy, meat savoury, vegetable, fruit and fish flavours. Synthetic flavours include Maillard reactants and reaction products including Amadori and Heyns rearrangement products and post-rearrangement products.

The seasoning and flavourings can contain one of more of a large number of herbs and spices, for example in fresh, dried, powdered or flaked form, or extracts thereof, and specific examples of herbs and spices include black and white pepper, paprika, chilli, turmeric, cayenne, coriander, ginger, pimento, cinnamon and nutmeg.

Examples of flavour enhancers include yeast-based ingredients such as yeast extracts, and hydrolysed vegetable proteins such as hydrolysed soya protein, and flavour enhancing salts such as monosodium glutamate.

Colouring agents can be included and these can be of either natural or synthetic origin. Examples of colouring agents include caramel, plant derived colouring agents such as anthocyanines, turmeric, paprika and beta-carotene, and non-toxic dyestuffs such as sunset yellow.

In order to lower the calorie content of the coating, or for dental reasons, sweetening can be provided in part or in total by artificial sweeteners such as aspartame, saccharin and acesulfame K, or by naturally occurring non-sugar sweeteners such as glycyrrhizinate.

Salt replacements can also be included if required and examples include potassium chloride and sodium chloride/potassium chloride mixtures).

In order to bulk out the flavouring and seasoning components, one or more diluents or solid carriers can be included, and examples of such diluents and carriers include those comprising or consisting essentially of one or more substances selected from:

(a) proteins, e.g. dairy proteins such as whole and skimmed milk powder, whey powder and whey permeate, and plant derived proteins such as soya protein;

(b) carbohydrates such as sugars, e.g. monosaccharides such as dextrose, or disaccharides such as lactose, starches, modified starches, and maltodextrins

(c) cellulose derivatives such as microcrystalline cellulose, methylcellulose, hydroxypropylmethyl cellulose, carboxymethyl cellulose, and

(d) inert flours and starches, e.g. cereal and potato flours and starches.

In order to impart other desirable properties to the coating compositions, various auxiliary substances can be included. Such auxiliary substances can, for example, be selected from:

(a) acidity regulating agents and buffering agents such as citric, tartaric, malic, ascorbic, succinic, propionic and acetic acids and salts thereof, phosphates (e.g. acidic phosphates and phosphates such as calcium phosphate; and basic and alkaline acidity regulating agents, for example carbonates such as sodium carbonate, bicarbonates such as sodium bicarbonate, and hydroxides such as magnesium hydroxide and calcium hydroxide.

(b) preservatives such as sulphites and metabisulphites; and

(c) antioxidants such as tocopherol, ascorbic acid, herbal extracts such as rosemary and tomato extracts, and beta-carotene; and

(d) vitamins and minerals such as vitamin A, B complex, C, D and E; iron, manganese and calcium.

The compositions of the invention are preferably formulated such that they contain less than 50%, for example less than 20%, preferably less than 10% by weight of particles derived from nuts.

Where the coating compositions of the invention are oil-based suspensions, the oils typically comprise glycerides (e.g. fatty acid triglycerides, diglycerides or monoglycerides or mixtures thereof) in the form of plant oils, animal oils or fish oils and/or blends and derivatives thereof (such as hydrogenated or partially hydrogenated oils).

Examples of plant oils include palm oil, olive oil, corn oil, sesame seed oil, castor oil, canola oil, cottonseed oil, safflower oil, coconut oil, rapeseed oil, sunflower oil, soya bean oil, and other forms of vegetable oil.

Examples of fish oils include herring oil, menhaden oil, cod liver oil and sardine oil.

Examples of animal oils include lard, tallow, mutton fat, beef fat, turkey fat, chicken fat or pork fat.

Vegetable oils are preferred.

The oils can be naturally occurring oils, e.g plant oils, fish oils or animal oils as described above, or they can be wholly or partially synthetic in nature. For example, the oils can be trans-esterification products of naturally occurring oils such as plant oils and other polyols such as propylene glycol and sorbitol.

The oils can have emulsifying properties which can be useful in a number of food contexts such as bread improvers compositions for example. Typically such emulsifying oils will contain mono-and/or di-glycerides, one particular example being diacetyl tartaric acid

esters of monoglycerides.

Preferred oils are those in which the most prevalent fatty acid residues in the oil are derived from oleic acid or linoleic acid or hydrogenates or partial hydrogenates thereof, for example those in which at least 50% of the fatty acid residues in the carrier oil are oleic acid residues.

Oil that are currently particularly preferred include palm olein and rapeseed oil.

The oils used in the suspensions can be liquid or semi-solid at room temperature, and it is generally preferred that the oil is liquid at a temperature below 45 degrees C. One preferred oil is palm olein.

In addition to, or instead of glycerides, the oils can contain fatty acid or medium or long chain carboxylic acid esters of other polyols such as propylene glycol, or sorbitol, or other sugars or sugar alcohols. Examples of sugar-derived oils include sucrose polyesters of long chain fatty acids such as the so-called "low calorie oils" and "zero-calorie oils" (Olestra), see for example US-A-3600186 and US-A-4005196.

The coating compositions of the invention are typically applied to a food item such as a snack food item by dipping, or tumbling, or spraying. For example, the suspension can be introduced into a tumbling vessel containing the food item by pumping from a reservoir or container (e.g. batch container), for example by means of a peristaltic pump. The suspension can be introduced into the container by tube feed as a liquid, or through a spray nozzle for example, or with the assistance of gas (e.g. air) pressure.

Where the oil base of the suspension is not liquid at room temperature, or where the viscosity characteristics (e.g. flowability) required for the coating process are not optimal at room temperature, the oil can be heated, e.g. to a temperature in the range from 45 degrees C to 50 degrees C in order to bring the oil into the required liquid state. However, in order to avoid the need to heat the oil, the oil base can be selected from oils which are liquid at room temperature, examples of such oils being rapeseed oil. The suspension can be maintained in a continuously stirred or agitated state (e.g. by high shear mixing) prior to discharge from the reservoir or storage vessel to the tumbling vessel.

The coating compositions of the invention have significantly improved adhesion characteristics compared to known coatings and an advantage of this is that the quantities of coating falling off of the surface of the food item during or after the coating operation are greatly reduced. Not only does this lead to a reduction in wastage but, moreover, the frequency with which production needs to be halted in order to clean the machinery and remove accreted coating materials is greatly reduced.

The adhesiveness of the coatings can be measured using the collet adhesion test as described in the Examples below. In the collet adhesion test, extruded hoop-shaped snackfood items (collets) are heated and coated using a measurable quantity of coating agent. The proportion of the coating agent adhering to the collet can then be determined and this measurement can be used to define the adhesiveness of the coating. By means of the invention, it has been found possible to provide coating compositions having an adhesiveness, as measured by the collet adhesion test, of greater than 85%, for example greater than 90%.

In order to provide the desired particle size distribution and mean particle size, the components of the composition are preferably pre-blended or pre-mixed in the oil carrier and milled together to the required size.

It has unexpectedly been found that the method used to mill the components of the coating has a significant effect on the properties of the suspension. More particularly, it has been found that high shear milling methods give suspensions with relatively poor rheological properties and a tendency to separate after a relatively short period. In contrast, high impact low shear milling methods such as ball milling have been found to give suspensions that remain stable even after chilling for several weeks and which have better mouthfeel and taste characteristics. In a ball mill, the components are tumbled with beads or balls of a hard material such as steel, or a ceramic or mineral material such as agate or zirconia, the impact of the beads or balls on the particles serving to break them into smaller particles but with minimal shearing forces being exerted on the particles. It is therefore preferred that the coating composition of the invention are prepared using a low shear high impact milling method such as ball milling.

Accordingly, in a further aspect, the invention provides a method of preparing a

liquid food composition (e.g. a coating composition) as hereinbefore defined, which method comprises mixing the components of the composition in the carrier liquid (e.g. carrier oil) and milling the mixture to give the suspension, preferably by means of a low shear high impact milling method such as ball milling.

In a still further aspect, the invention provides a food item (such as a snack food) coated with, or disposed in a liquid food composition (e.g. a coating composition) as hereinbefore defined.

In another aspect, the invention provides a method of coating a food item comprising dipping the foodstuff in, or spraying or tumbling the foodstuff with, a coating composition as hereinbefore defined.

Brief Description of the Drawings

Figure 1 is a comparative graph showing the particle size distributions of three coating compositions, a first composition being a milled composition in accordance with the invention, a second composition representing a standard formulation and a third composition being an unmilled blend of solid ingredients.

Figure 2 is a graph showing the particle size distribution of the milled first composition in Figure 1

Figure 3 is a graph showing the particle size distribution of the standard formulation in Figure 1.

Figure 4 is a graph showing the particle size distribution of the unmilled blend composition in Figure 1

Detailed Description of the Preferred Embodiments

The invention will now be illustrated in more detail by reference to the following non-limiting examples.

EXAMPLE 1

Preparation of a Cheese-flavoured Coating

A cheese flavoured coating composition suitable for coating extruded snackfoods of the collet type was prepared from the following ingredients:

Ingredient	Concentration % (w/w) of total solids
cheese powder	35 - 40
whey powder	35 - 40
salt	10 - 15
monosodium glutamate	0 - 5
calcium phosphate	0 - 5
silica	0 - 5
spice extracts	0 - 5
sodium hexacyanoferrate (anti-caking agent)	0 - 5

The foregoing ingredients were dry blended and a quantity of the blend was mixed with a palm olein oil (melting point approx. 38 degrees C) to form a slurry containing approximately 30% solids. The slurry was then milled in a Dyno-Mill type KDL-A Ball Mill (available from Willy A. Bachofen AG Maschinenfabrik, Basel, Switzerland, or from Glen Creston Limited, Stanmore, Middlesex, England) using polyurethane agitator discs and zirconia (YTZ) grinding beads of 1mm diameter. The conditions employed were as follows: peripheral disc speed 8.5, pressure 0 Bar, flow rate 8 litres per hour, inflow temperature ambient, and outflow temperature 34-39 degrees C.

The resulting suspension product had a smooth creamy consistency and an orange coloration. The suspension was left for several weeks at room temperature and only minimal settling was observed.

COMPARISON OF THE MILLED SUSPENSION OF EXAMPLE 1 WITH NON-MILLED COMPOSITIONS

The properties of the milled composition described above were compared with the

properties of the composition prior to milling and a second reference composition containing the same ingredients as the composition of Example 1 except that the whey powder contained particles of a greater particle size and a broader particle size distribution.

The three formulations were subjected to particle size analysis using a Malvern Mastersizer 2000 laser particle sizer. A comparison of the particle size distributions of the three formulations is shown in Figure 1, from which it is evident that the milled formulation of Example 1 has a much narrower particle size distribution and a lower mean particle size than the other two formulations.

The individual particle size distribution graphs are shown in Figures 2, 3 and 4, and the particle size distribution data are shown in Tables 2, 3 and 4.

In Table 5, the mean particle size, specific surface areas, and particle size distributions (d values) are compared.

As can be seen, the milled formulation has a much smaller mean particle diameter (10.017μm) than either of the unmilled formulations. Similarly, the particle size distributions, as represented by the d[0.1], d[0.5] and d[0.9] values are considerably smaller than for the unmilled formulations. It will also be noted that the particle size distribution exhibited by Example 1 is monomodal whereas in the two unmilled formulations, the distributions appear to be bimodal.

TABLE 2

PARTICLE SIZE DISTRIBUTION FOR MILLED FORMULATION OF EXAMPLE 1

Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %
0.020	0.00	0.399	0.01	7.096	6.79	126.191	0.00
0.022	0.00	0.448	0.03	7.962	7.09	141.589	0.00
0.025	0.00	0.502	0.06	8.934	7.14	158.866	0.00
0.028	0.00	0.564	0.09	10.024	6.93	178.250	0.00
0.032	0.00	0.632	0.12	11.247	6.50	200.00	0.00
0.036	0.00	0.710	0.14	12.619	5.88	224.404	0.00
0.040	0.00	0.796	0.16	14.159	5.11	251.785	0.00

Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %
0.045	0.00	0.893	0.19	15.887	4.29	282.508	0.00
0.050	0.00	1.002	0.24	17.825	3.44	316.979	0.00
0.056	0.00	1.125	0.29	20.000	2.67	355.656	0.00
0.063	0.00	1.262	0.38	22.440	1.97	399.052	0.00
0.071	0.00	1.416	0.48	25.179	1.40	447.744	0.00
0.080	0.00	1.589	0.62	28.251	0.93	502.377	0.00
0.100	0.00	1.783	0.78	31.698	0.59	563.677	0.00
0.112	0.00	2.000	0.98	35.566	0.29	632.456	0.00
0.126	0.00	2.244	1.21	39.905	0.12	709.627	0.00
0.142	0.00	2.518	1.50	44.774	0.01	796.214	0.00
0.159	0.00	2.825	1.87	50.238	0.00	893.367	0.00
0.178	0.00	3.170	2.31	56.368	0.00	1002.374	0.00
0.200	0.00	3.557	2.85	63.246	0.00	1124.683	0.00
0.224	0.00	3.991	3.48	70.963	0.00	1261.915	0.00
0.252	0.00	4.477	4.19	79.621	0.00	1415.892	0.00
0.283	0.00	5.024	4.93	89.337	0.00	1588.656	0.00
0.317	0.00	5.637	5.65	100.237	0.00	1782.502	0.00
0.356	0.00	6.325	6.30	112.468	0.00	2000.00	0.00

TABLE 3

PARTICLE SIZE DISTRIBUTION FOR UNMILLED COMPOSITION OF EXAMPLE 1

Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %
0.020	0.00	0.356	0.00	6.325	0.38	112.468	5.74
0.022	0.00	0.399	0.00	7.096	0.50	126.192	5.35
0.025	0.00	0.448	0.00	7.962	0.63	141.589	4.86
0.028	0.00	0.502	0.00	8.934	0.75	158.866	4.33
0.032	0.00	0.564	0.00	10.024	0.86	178.250	3.78
0.036	0.00	0.632	0.00	11.247	0.94	200.000	3.24
0.040	0.00	0.710	0.00	12.619	1.00	224.404	2.72
0.045	0.00	0.796	0.00	14.159	1.02	251.785	2.22
0.050	0.00	0.893	0.00	15.887	1.02	282.507	1.77
0.056	0.00	1.002	0.00	17.825	1.02	316.979	1.34

Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %
0.063	0.00	1.125	0.00	20.000	1.03	355.656	0.96
0.071	0.00	1.262	0.00	22.440	1.09	399.053	0.64
0.080	0.00	1.416	0.00	25.179	1.22	447.744	0.36
0.89	0.00	1.589	0.00	28.251	1.46	502.377	0.09
0.100	0.00	1.783	0.00	31.698	1.82	563.677	0.02
0.113	0.00	2.000	0.00	35.566	2.29	632.456	0.00
0.126	0.00	2.244	0.00	39.905	2.87	709.627	0.00
0.142	0.00	2.518	0.00	44.774	3.52	796.214	0.00
0.159	0.00	2.825	0.00	50.238	4.21	893.367	0.00
0.178	0.00	3.170	0.00	56.368	4.85	1002.375	0.00
0.200	0.00	3.557	0.00	63.246	5.41	1124.683	0.00
0.224	0.00	3.990	0.06	70.963	5.83	1261.915	0.00
0.252	0.00	4.477	0.10	79.621	6.07	1415.892	0.00
0.282	0.00	5.024	0.19	89.337	6.14	1588.657	0.00
0.317	0.00	5.637	0.27	100.237	6.02	1782.502	0.00
						2000.00	0.00

TABLE 4

PARTICLE SIZE DISTRIBUTION OF STANDARD FORMULATION

Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %
0.264	0.00	2.560	0.00	24.801	1.45	240.225	4.13
0.308	0.00	2.979	0.00	28.854	1.61	279.487	2.81
0.358	0.00	3.466	0.00	33.570	1.97	325.166	1.67
0.416	0.00	4.032	0.00	39.057	2.55	378.311	0.79
0.484	0.00	4.691	0.14	45.440	3.37	440.142	0.21
0.563	0.00	5.458	0.29	52.867	4.39	512.079	0.00
0.656	0.00	6.350	0.45	61.507	5.53	595.772	0.00
0.763	0.00	7.388	0.61	71.560	6.66	693.145	0.00
0.887	0.00	8.596	0.81	83.255	7.60	806.432	0.00
1.032	0.00	10.000	1.03	96.863	8.25	938.235	0.00
1.201	0.00	11.634	1.24	112.694	8.50	1091.579	0.00
1.397	0.00	13.536	1.39	131.112	8.32	1269.966	0.00

Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %	Size (μm)	Volume in %
1.626	0.00	15.748	1.45	152.541	7.71	1477.551	0.00
1.892	0.00	18.322	1.44	177.472	6.73	1719.041	0.00
2.201	0.00	21.317	1.42	206.478	5.48	2000.00	0.00

TABLE 5

COMPARISON OF PARTICLE SIZE PARAMETERS

Sample	Volume Weighted Mean (μm)	Specific Surface Area (m^2/g)	d[0.1] (μm)	d[0.5] (μm)	d[0.9] (μm)
Example 1 Milled	10.017	0.97922	3.317	8.549	18.634
Example 1 Unmilled	110.566	0.11917	22.996	88.650	225.478
Comparison	121.721	0.1071	24.061	105.495	237.400

Determination of the Viscosities of the Suspensions

The three suspensions identified in Tables 2 to 5 above and described in Example 1 were subjected to viscosity analysis using a Brookfield DV-1 viscometer equipped with a number 2 spindle. The viscosities (calculated as an average over a five minute period) at a water bath temperature of 45 degrees C and a rotational speed of 100 rpm for the three formulations were as follows:

Table 6

Sample	Viscosity ($mPas^{-1}$)
Example 1 - Milled	31.017
Example 1 - Unmilled	19.653
Standard Formulation - Comparison	18.678

Thus, as can be seen from the results above, the milled formulation of Example 1 exhibited much greater viscosity than the unmilled formulations.

The effects of milling the formulations, and the consequent smaller particle size and higher viscosity, on the adhesiveness of the suspension to snack food items was then determined as set out below.

Determination of Adhesiveness of Suspension

Collet Adhesion Test

The suspension formed by the method of Example 1 was subjected to the collet adhesion test to measure its adhesiveness in relation to standard snackfood collets.

Test Protocol

Plain collets (74g) were weighed into a plastics bowl and heated at full power for 1.5 minutes in a microwave oven (Toshiba). The warmed collets were then transferred into a pre-weighed polyethylene bag (50 x 75 cm) and a quantity of the suspension of Example 1 was poured into the bag. The bag was inflated, closed and shaken for one minute. The coated collets were then tipped into a plastics bowl and weighed. The bag and residual coating in the bag were also weighed and the amount of residual coating remaining on the bag was determined.

The Adhesiveness (A) of the suspension is defined as the percentage of the suspension applied to the collets that remain on the collets after shaking. By means of this technique, the ball-milled composition is found to have considerably better adhesiveness than the unmilled composition or the standard composition.

TEST COMPOSITIONS

COMPARISON OF THE EFFECT OF DIFFERENT MILLING METHODS ON THE PROPERTIES OF THE SUSPENSIONS

Several different milling techniques were used to determine the effects of the milling technique upon the properties of the suspension. Three mixing/milling machines were employed, namely a Silverson Benchtop high shear mixer, an Urschel Comitrol High Shear mixer and a "Dyno-Mill" (Glen Creston) Ball Mill (as above).

The Silverson high shear mixer is widely used to mix, emulsify, homogenise, solubilise, suspend, disperse and disintegrate solids. The solid material undergoes a milling

action as it is forced through specific screen sizes.

The Comitrol machine makes use of the principle of incremental shear and centrifugal force to ensure highly efficient comminution by rotating the product inside a stationary reduction head at high rotational speeds.

The Dyno-Mill Ball Mill machine makes use of high impact ball milling machine makes use of high impact ball milling using grinding beads (e.g. zirconia beads) balls having a bead diameter of 1mm.

The results of the comparative milling tests showed that the High Shear Silverson and Urschel machines produced samples with relatively poor rheological properties when using rape seed and palm olein oils.

Thus, although the milling produced a reduction in particle size distribution, and immediate formation of a suspension of the seasoning within the slurry, the slurry was found to be unstable over periods of more than ten minutes. Moreover, the high shear and friction generated using the Silverson and Urschel methods caused significant increases in temperature thereby possibly leading to rancidity and sensory problems. Furthermore, the samples gave a gritty mouthfeel, which could be due to fat crystallisation and inconsistent particle size reduction of the seasoning.

By comparison, the Dyno-Mill (Glen Creston) ball milling method produced suspensions which are stable at ambient and under chilled storage with no loss of suspension stability over a two week period. Moreover, the grittiness present in the two other trial formulations was not observed with ball milling method.

On the basis of the above results, it is concluded that the ball milling of the suspensions provides a more stable and more palatable coating than compositions milled/commuted by other means.

EXAMPLE 2

TOMATO SAUCE MIX

A tomato sauce mix is formed by mixing the following ingredients in water and milling the mixture using a Dyno-Mill ball mill as described in Example 1 to give a suspension having a similar particle size distribution.

Ingredient	Conc. Range (%)	Conc. Specific (%)
sugar	1.5 - 20	2.25
salt	0.5 - 10	1.35
flavouring	0 - 5	0.03
pepper	0 - 5	0.03
starch	0.1 - 10	1.125
tomato powder	0.1 - 50	6.885

EXAMPLE 3

HOT WATER THICKENING CHEESE SAUCE MIX

A cheese sauce mix is prepared by mixing the following ingredients in water and then milling the mixture in a Dyno-Mill ball mill as described in Example 1.

Ingredient	Conc. Range (%)	Conc. Specific (%)
milk powder	0.1 - 15	2.325
fat powder	0.1 - 15	2.1
salt	0 - 5	0.675
yeast	0 - 5	0.075
pepper	0 - 5	0.03
turmeric	0 - 5	0.075
garlic powder	0 - 5	0.075
mustard flour	0 - 5	0.075
flavour	0 - 5	0.375
flour	0 - 5	0.15
whey powder	0 - 7	0.9
processing aid	0 - 6	0.3
cheese powder	0 - 15	3.555
starch	0 - 15	3.81

EXAMPLE 4

BREAD IMPROVER MIX

A bread improver mix is prepared by mixing the following ingredients with a liquid emulsifier base and then milling the mixture using a Dyno-Mill ball mill as described in Example 1. The resulting suspension remains stable for prolonged periods without settling.

Ingredient	Concentration (%)
enzyme (e.g. amylase)	1 - 10
ascorbic acid	1 - 10
emulsifier (E-472e)	q.s. to 100

In the above formulation, the liquid emulsifier comprises diacetyl tartaric acid esters of monoglycerides and is sufficiently liquid to give the required flow properties in use. For emulsifiers having a higher viscosity, oils such as vegetable oils can be added to thin the liquid to the desired viscosity.

It will readily be apparent that numerous modifications and alterations could be made to the compositions described in the Examples, without departing from the principles underlying the invention, and all such modifications and alterations are intended to be embraced by this Application.

CLAIMS

1. A liquid food composition in the form of a suspension of particles of foodstuff in a carrier liquid, excluding sugar-in-oil suspensions and nut pastes and nut butters; the particles having a mean particle size of less than 100 micrometres and a particle size distribution whereby the d[0.5] value is less than 100 micrometres and the d[0.9] value is less than 300 micrometres.

2. A liquid food composition according to claim 1 wherein the carrier liquid is an oil.

3. A liquid food composition according to claim 1 or claim 2 which is selected from functional food suspensions such as drinks (e.g. stimulant suspensions, isotonic/energy drinks, recovery/jet lag cure drinks), sauces (e.g. sauces selected from curry, garlic, bechamel, tomato, cheese, butter, gravy, chocolate, vanilla and lemon sauces), glazes, bread improver compositions, bouillons, marinades and custards, yield improvers, phosphate suspensions, functional protein suspensions, coating suspensions (e.g. for snackfoods), preservatives, colouring agents and colouring systems, and batters.

4. A coating composition for coating a food item, the coating composition being in the form of a suspension of particles in a carrier oil; the particles having a mean particle size of less than 100 micrometres and a particle size distribution whereby the d[0.5] value is less than 100 micrometres and the d[0.9] value is less than 300 micrometres.

5. A coating composition (other than a sugar-in-oil suspension or a nut butter or nut spread) for coating a food item (such as a snack food), the coating composition being in the form of a suspension of particles in a carrier oil; the particles having a mean particle size of less than 50 micrometres, the composition having a solids content of from 20% to 49% (w/w) and containing a free-flow enhancing agent.

6. A coating composition according to claim 5 wherein the free-flow enhancing agent is a phosphate such as calcium phosphate.

7. A composition according to any one of the preceding claims wherein the particle size

distribution such that the d[0.9] value is less than 250 micrometres, for example less than 200 micrometres.

8. A composition according to any one of claims 1 to 4 wherein the mean particle size is less than 50 micrometres (for example less than 20 micrometres, preferably less than 15 micrometres) and the particle size distribution is such that the d[0.5] value is less than 20 micrometres.

9. A composition according to any one of claims 5 to 8 wherein the d[0.9] value is less than 50 micrometres.

10. A composition according to any one of claims 5 to 9 wherein the d[0.1] value is less than 10 micrometres.

11. A composition according to claim 7 wherein the particle size distribution is such that the d[0.1] value is less than 8 micrometres, the d[0.5] value is less than 15 micrometres and the d[0.9] value is less than 25 micrometres.

12. A composition according to claim 8 wherein the particle size distribution is such that the d[0.1] value is less than 5 micrometres, the d[0.5] value is less than 10 micrometres and the d[0.9] value is less than 20 micrometres.

13. A composition according to any one of the preceding claims wherein the particle size distribution is monomodal.

14. A composition according to any one of the preceding claims having a viscosity in the range from 30 $mPas^{-1}$ to 200 $mPas^{-1}$ (e.g. 50 - 100).

15. A composition according to any one of the preceding claims which is a coating composition comprising or consisting essentially of flavouring or seasoning components and optionally diluents or carriers therefor.

16. A coating composition according to claim 15 wherein the flavouring or seasoning components comprise one or more selected from base materials, flavoured base

materials, processing aids, acidic base materials, flavours, herbs and spices, flavour enhancers, colours, and artificial sweeteners.

17. A composition according to any one of the preceding claims wherein the liquid carrier is liquid at a temperature below 45 degrees C.

18. A composition according to claim 17 wherein the liquid carrier is liquid at a temperature below 30 degrees C.

19. A composition according to any one of the preceding claims wherein the particle size distribution is monomodal.

20. A composition according to any one of the preceding claims wherein the components of the composition have been milled together to give the said mean particle size and particle size distribution.

21. A composition according to claim 20 wherein the said components have been milled to give the said mean particle size and particle size distribution using a low shear high impact milling method.

22. A composition according to claim 21 wherein the said components have been milled together in a ball mill.

23. A coating composition according to any one of the preceding claims which is substantially free from nuts or nut-derived ingredients.

24. A coating composition according to any one of the preceding claims having an adhesiveness, measured by the collet adhesion test described herein, of greater than 85%, for example greater than 90%.

25. A composition according to any one of the preceding claims wherein the solids content is of the order of approximately 15% to 55% (w/w), for example from 20% to 49% (w/w), preferably from 25% to 35%, e.g. approximately 30% (w/w).

26. A composition according to any one of the preceding claims wherein the carrier liquid is an oil selected from palm olein ad rapeseed oil.

27. A composition according to any one of the preceding claims which is a bread improver composition.

28. A bread improver composition according to claim 27 which comprises a bread improving agent suspended in an emulsifying oil.

29. A bread improver composition according to claim 28 wherein the emulsifying oil comprises a liquid emulsifier and optionally a vegetable oil.

30. A bread improver composition according to claim 28 or claim 29 wherein the bread improving agent comprises ascorbic acid and optionally an enzyme such as an amylase.

31. A food item coated with a composition according to any one of claims 1 to 26.

32. A food item according to claim 31 which is a snack food.

33. A method of coating a food item comprising dipping the foodstuff in, or tumbling or spraying the foodstuff with, a composition as defined in any one of claims 1 to 26.

34. A method of preparing a composition as defined in any one of the preceding claims, which method comprises mixing the components of the composition in the carrier liquid and milling the mixture to give the suspension.

35. A method according to claim 34 wherein the milling of the mixture is effected by means of a low shear high impact milling method.

36. A method according to claim 35 wherein the milling method is ball milling.

37. A snackfood item coated with a coating composition in the form of a suspension of particles in a carrier oil; the particles having a mean particle size of less than 100

micrometres and a particle size distribution whereby the d[0.5] value is less than 100 micrometres and the d[0.9] value is less than 300 micrometres.

38. A liquid food composition substantially as described herein with reference to the examples and/or the accompanying drawings.

39. A method of preparing a liquid food composition substantially as described herein with reference to the examples and/or the accompanying drawings.

40. A food item coated in a liquid food composition substantially as described herein with reference to the examples and/or the accompanying drawings.

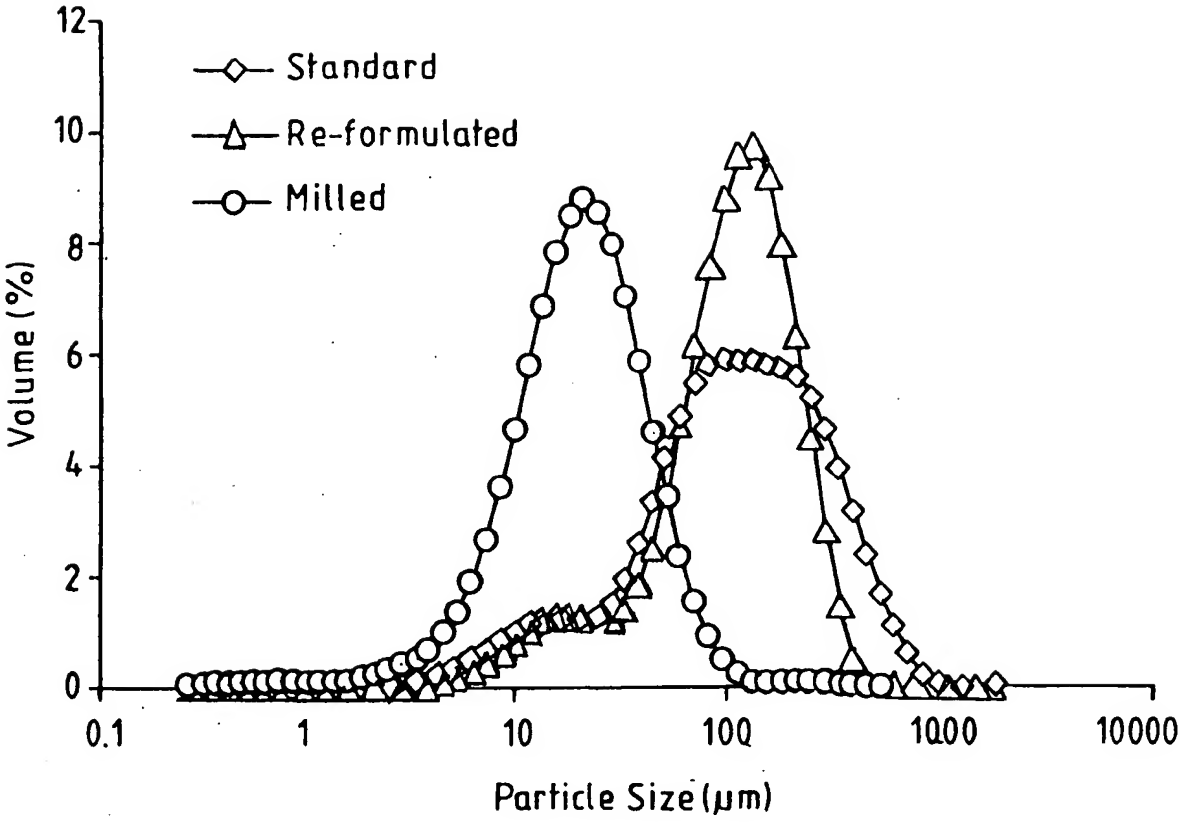
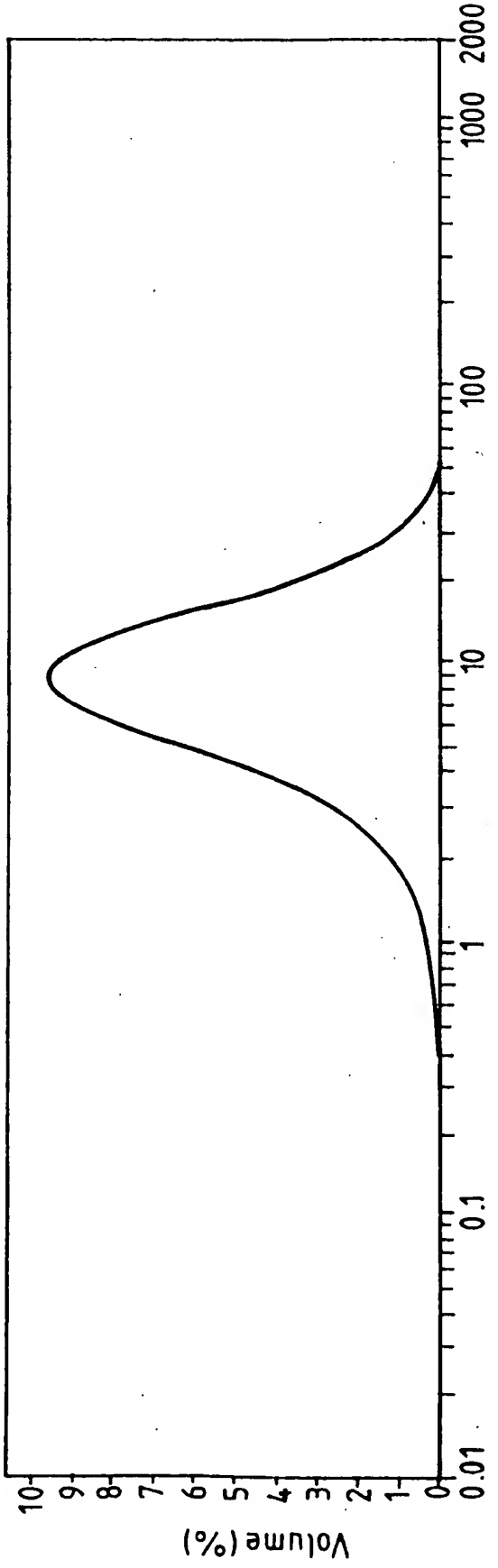

Standard
Re-formulated
Milled
Volume (%)
12
10
8
6
4
2
0
0.1
1
10
100
1000
10000
Particle Size (µm)

Fig.1.


Volume (%)
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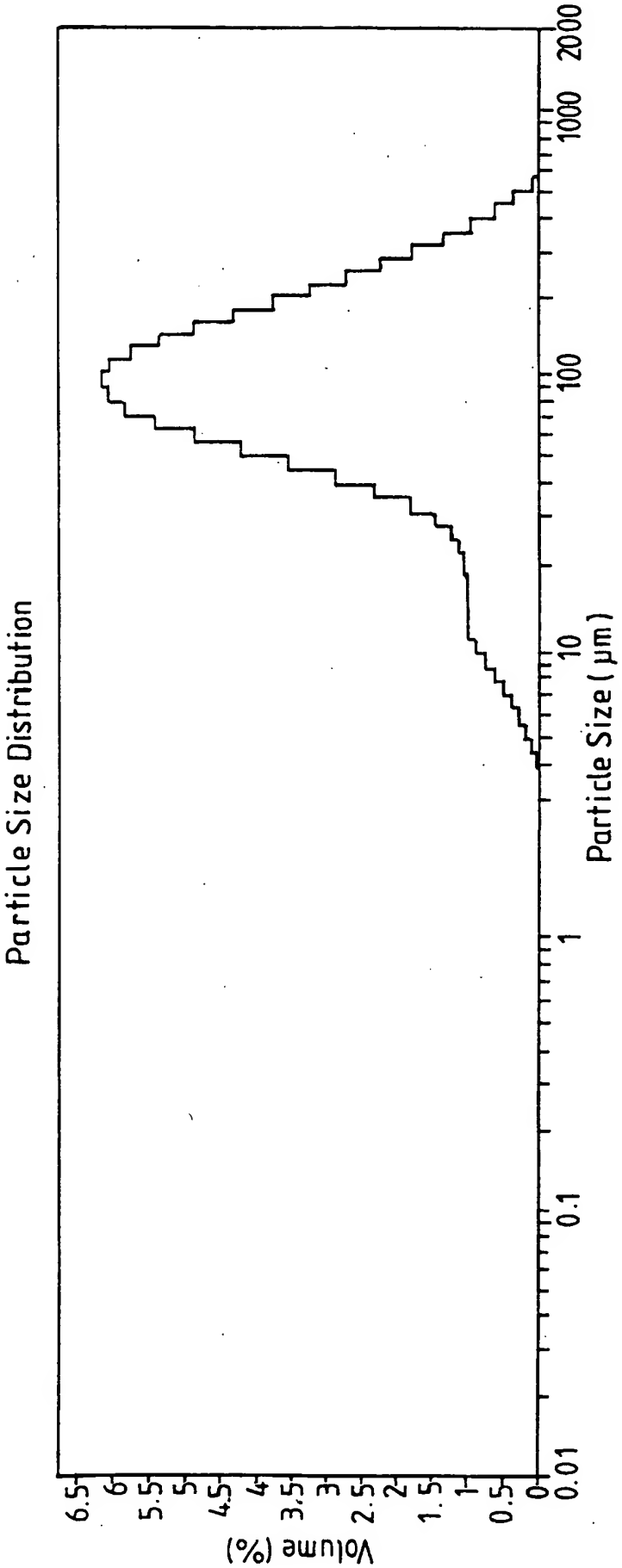
1
2
3
4
5
6
7
8
9
10
0.01
0.1
1
10
100
1000
2000
Particle Size (µm)

Fig.2.


Particle Size Distribution
Volume (%)
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0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
0.01
0.1
1
10
100
1000
2000
Particle Size (µm)

Fig.3.

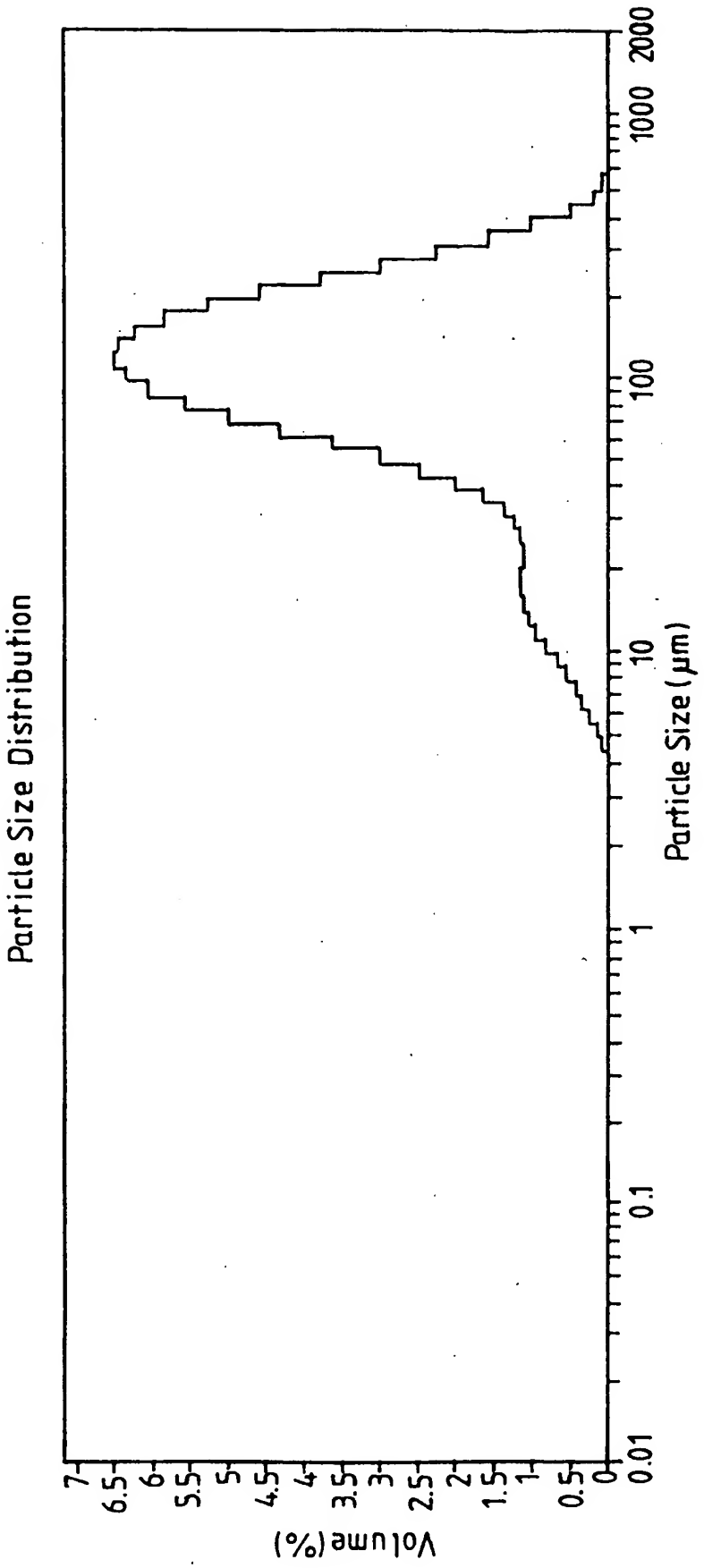
Particle Size Distribution
Volume (%)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
0.01
0.1
1
10
100
1000
2000
Particle Size (µm)

Fig.4.

INTERNATIONAL SEARCH REPORT

Int. ional Application No
PCT/GB 00/02644

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A23P1/08 A23L1/164 A23L1/39 A21D2/16 A23C19/09
A23L1/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A23P A23L A21D A23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
WPI Data, PAJ, EPO-Internal, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	EP 0 560 609 A (GEN FOODS INC) 15 September 1993 (1993-09-15) example 1 page 3, line 24 -page 4, line 2 ---	1-4, 7-25, 34-36, 38,39
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 November 2000	22/11/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vuillamy, V

INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/GB 00/02644

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

Int. ional Application No
PCT/GB 00/02644

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